cesses of intensification or methods of repeated printing from quick plates to slow plates.

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In the case of very long sparks, six feet, or more, the bifurcations are generally directed to neighboring conducting masses, and are not directed to the cathode. In the case of lightning, masses of clouds at a low potential, not lying along the main direction of discharge, are indicated by these side forking discharges.

* * * * * * *

Some years ago I showed that an explosion occurs whenever powerful sparks change their direction in zig zags. The spark passed between a plate of glass and a sheet of paraffined paper, and it was found that the paper was perforated at each forking of the discharge. Possibly these explosions occurring along an extended lightning discharge may be an important element in the phenomenon of the rolling thunder, for the sound of such explosions would arrive at considerable intervals apart.

An interesting account of the explosive effect at each turning point of a lightning discharge has been given me by Mr. Harvey N. Davis, an instructor in the Jefferson Physical Laboratory, and I give it here, since it is an account by a skilled observer of both the above explosive effects and ball lightning.

"During the 27th of August, 1906, a large boarding-house on the side of Mount Moosilauke, in the town of Warren, N. H., was struck by lightning in an unusually sudden and severe thunderstorm. The path of at least three independent discharges could be traced, but they must have been practically simultaneous, for those who had been caught by the rain half a mile from the house heard only one sharp report. One of the discharges struck the end of the ridgepole of the barn, and came down the wall to a very obvious ground; and two others landed halfway up the sloping roof of the nearest part of the house, one of them near, but not on a dormer window, and the other at some distance from any sort of a projection such as would ordinarily be expected to 'draw lightning.' In each place there was a spot about a foot across where the shingles had been forced outwards, as though by an explosion just under them, while inside there were two round holes four or five inches in diameter where the plaster had been blown into the room, leaving the laths completely bare. The first of these discharges travelled down the roof to the eaves, and jumped to the telephone wires, bursting out the shingles again as it left the roof. It happened that one of the young women of the house had just closed the dormer window, and was in the middle of the room with her head close to that part of the sloping ceiling where the second of the holes was found. It is possible that this was merely chance, or, on the other hand, her presence may have had some inflence on the direction of the original discharge; at any rate, the discharge jumped to her right shoulder, and passed through or over the surface of her body to her left foot, then ran along the floor to the wall, leaving a mark such as might be made with a hot poker, and finally reached earth through the side of the house. The young woman was, of course, completely stunned, but was fortunate enough to escape serious injury. An interesting feature of this discharge was the regularity with which it seemed to explode every time it turned a corner. The explosions between the ceiling and the roof have already been mentioned; the next occurred when the discharge reached the woman's foot. Her shoe and stocking were blown completely off, so that only the left half of the upper of the shoe remained attached to the sole. From her foot it ran along the floor to a tin pail, which was standing on a piece of linoleum, and here it exploded again, overturning the pail, and demolishing the linoleum, some of which was found inside a water pitcher on a stand near by, while one or two shreds reached an adjacent windowpane with force enough to stick between the glass and the sash. Finally, the point where the lightning reached the wall and started down between the sheathing and plaster was very plainly marked on the outside of the house, a couple of clapboards being forced out several inches. In the room below, the plaster was loosened from the laths all the way down, probably by the pressure of the heated air, but the appearance was quite different from that of the ceiling in the room above. Fortunately nothing took fire.

"At the time of the discharge the guests were in the dining-room at the other side of the house, and several of those who turned most quickly saw slow moving ball discharges just outside the window. One of those with whom I talked, a trained scientist, was sitting with his back partly turned, and saw only one ball of fire, 'like a glowing coal;' but others said that it had been preceded by one rather larger, perhaps as large as a baseball. When he first saw the second ball, it was three or four feet from the ground, and was falling obliquely, as though it had rolled off the roof of a low ell near by, and its velocity was only a few feet per second, certainly not enough to leave a streak on his retina, as he noticed at the time. We searched that night, and again carefully the next day, for traces of these discharges in the ground, but could find none. Whether they were independent discharges from the main cloud, or were secondary effect, due to the electrification of the wet roof, I do not know. At any rate, they were not immediately connected with either of the three main discharges, for two of these went to obvious grounds, as has been indicated; and the telephone wires, which carried off the third, were nowhere near the part of the house where these balls were seen."

In long discharges of lightning these explosions, directed at varied angles, could give rise to sound waves, which, starting practically at the same instant, nevertheless, by different angles and degrees of reflection, could arrive at the ear of the listener at considerable intervals, and produce the rolling of thunder.

What, then, are the conclusions that can be drawn from the foregoing manifestations of electric discharges which can be produced by a large number of storage cells? The first fact which impresses one is the importance of the consideration of amperage as well as electromotive force. Throughout scientific literature, and in popular conception, electromotive force has received the chief consideration in discussing the phenomena of lightning. Experiments in laboratories have been conducted with electrical machines which are generally incapable of affording much current. Franklin's experiment with the aid of a kite illustrates an underestimate of the current in a lightning discharge. Even to-day no one would think of repeating Franklin's celebrated experiment, largely from a dread of voltage, but with little conception of the possibility of danger from small voltage and large current. We are beginning to realize, however, that 500 volts, accompanied by a current of from 10 to 20 amperes, is sufficient to destroy human life. One compartment of the storage battery which I have described in this memoir—a compartment affording something over 800 volts—short-circuited through the body of the janitor of the laboratory, was sufficient to knock him senseless.

The most powerful electric discharge which we can produce by modern appliances in a faint shadow of lightning—so faint that it fails to reproduce in most essential respects the phenomena in the heavens. I have never been able, by the use of resonant tubes or other arrangements, to cause reverberations to reproduce in the slightest degree, even with sparks six feet in length, the rolling of thunder. The energy of an ordinary lightning discharge must be enormous.

The forms of lightning discharges are very varied, and when one asks whether lightning is oscillatory, one should specify the kind of discharge.

A COLLECTION OF MEAN ANNUAL TEMPERATURES FOR MEXICO AND CENTRAL AMERICA.

By PHILIP P. CALVERT, Ph. D. Assistant Professor of Zoology, University of Pennsylvania, Philadelphia, Pa.

In studying the distribution of the Odonata, or dragonflies, of Mexico and Central America, particularly with reference to temperature, the writer prepared a colored map illustrating the distribution of mean annual temperatures in those countries. This map is shortly to appear as a plate in the Biologia Centrali-Americana volume Neuroptera (London). It is based partly on two similar older maps,[1] partly on a body of temperature data specially gathered from many scattered sources in the libraries of Philadelphia and of the United States Weather Bureau at Washington. As these data will probably be of use to climatologists and others, they are here brought together in tabular form. Since the authorities cited for temperature records often give other climatic data also, the column "Authority for temperature records" will also serve as a selected bibliography on meteorological phenomena in these countries. In the search for the earlier authorities much assistance was derived from Sr. Aguilar y Santillan's "Bibliografia Meteorologica Mexicana" in the Memorias de la Sociedad Cientifica Antonio Alzate, IV, p. 5–47, 265–276, 1890. The student of Mexican temperatures will also find Sr. J. Guzman's "Climatología de la República Mexicana desde el punto de vista higiénico" in the same Memorias, XX, p. 181-

[1] 1. A map, 97 by 71.5 centimeters, in the library of the Academy of Natural Sciences of Philadephia, inscribed merely "Carta Climatologica. Sebastian Reyes. P. J. Senties. A. Donamette Imp. Escala de 1:3,000,000. Gravée chez Monrocq fr. Paris." Thanks to the Secretaria de Estado y del Despacho de Fomento, Colonizacion e Industria of Mexico, I am informed, under date of July 30, 1907, "que dicha Carta fué publicada en 1889 por disposicion de esta Secretaría, haciendo los trabajos relativos los Sres. Pedro J. Senties, que era Director de la Escuela Nacional de Agricultura y Comisionado de México en la Exposicion de Paris del mismo año y Sebastian Reyes que fué Profesor del Plantel antes mencionado." This map was reproduced without alteration, but on a reduced scale (1:6,000,000), in Tomo XI, Anales del Ministerio de Fomento de la Republica Mexicana, Mex., 1898.

2. A map entitled "Reparticion de la Temperatura en la República Mexicana" for the "Año Meteorológico de 1902," published as Planche 16, Boletin Mensuel, Observatorio Meterológico-Magnetico Central de México, Noviembre, 1902. Señor Don Manuel E. Pastrana, Director of the Observatorio, has kindly informed me (September 6, 1907) that the maps for later years have not yet been published.

TABLE 1.—*Mean annual temperaturez in Mexico.*

Locality.	State.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
			Feet.	Meters.	°C.	°F.	Years.	Date.	
		° ′							
Acapulco	Guerrero	16 50	14	4	27.5	81.5	11 mos.	1901–1902	BOM 1901 and 1902.
Acayucan	Vera Cruz	17 57	518	158	24.5	76.1	5		CRM II, p. 136.
Actopan	do	19 30	1,020	311	25.0	77.0	6		Do.
Acula	do	18 30			24.4	76.0	5		Do.
Aguascalientes	Aguascalientes	21 53	6,104	1,861	18.1	64.6	2		Hann.
Alpatlahua	Vera Cruz	19 7*	5,540	1,689	14.8	58.6	7		CRM II, p. 134.
Alvarado	do	18 46	29	9	26.4	79.5	6		CRM II, p. 136.
Antigua, La	do	19 19*			24.9	76.8	4		Do.
Apazapan	do	19 19*	1,181	360	24.8	76.6	5		Do.
Atzalan	do	19 47*			16.0	60.8	5		CRM II, p. 134.
Axocuapan	do				15.4	59.7	7		Do.
Catemaco	do	18 25	1,305	398	24.3	75.7	6		CRM II, p. 135.
Chacaltianguis	do	18 19*			23.8	74.8	4		Do.
Chiconamel	do				24.1	75.4	5		Do.
Chicontepec	do	20 58	1,952	595	22.0	71.6	6		Do.
Chihuahua	Chihuahua	28 38	4,759	1,451	18.2	64.8	2	1901, 1902	BOM 1901, p. 224; 1902, p. 625.
Chontla	Vera Cruz	21 18*			23.0	73.4	5		CRM II, p. 135.
Coatepec	do	19 27*	4,107	1,252	19.2	66.6	4		CRM II, p. 134.
Coatzacoalcos	do	18 9	6	2	26.3	79.3	5		CRM II, p. 136.
Do	do				24.8	76.6	58 mos.	1899–1904	MWR 1899–1904.
Colima	Colima	19 11	1,601	488	26.1	79.0	12	1869–1880	Barreto, Revista Cient. Mex. i. No. 12, 1880.
Do	do				24.5	76.1	5	1896, 1897, 1899, 1901, 1902	BOM 1897, 1899, 1902. MS 1901; CRM II, p. 14.
Comapa	Vera Cruz				19.7	67.5	7		CRM II, p. 134.
Cordoba	do	18 54	2,860	872	20.5	68.9	5	1861–1865	Challenger Repts.
Do	do				20.0	68.0	7		CRM II, p. 134.
Cosamaloapan	do	18 22	295	90	24.5	76.1	7		CRM II, p. 136.
Coscomatepec	do	19 4	5,209	1,588	16.8	62.2	7		CRM II, p. 134.
Cosquihui	do				22.9	73.2	5		CRM II, p. 135.
Cuernavaca	Morelos	18 55	4,936	1.505	20.5	68.9	2	1873–1874, 1907	Reyes, Bol. Soc. Geog. Estadist. Rep. Mex. (3a), IV, p. 90 et seq., 1878. MS 1907.
Culiacan	Sinaloa	24 48	111	34	25.2	77.4	5	1891–1894, 1900	BOM 1894, 1900. MS 1891, 1893.
Durango	Durango	24 1	6,207	1,892	17.3	63.1	2	1899, 1900	BOM 1899, 1900.
Guadalajara	Jalisco	20 41	5,186	1.581	19.7	67.5	12	1880–1885, 1889, 1894, 1896, 1897, 1902, 1903.	Barcena, Anales Min. Fomento. Rep. Mex. IX, p. 277–328, 1891. BOM 1889, 1895, 1897, 1902; CRM II, p. 14; MWR 1902, 1903.
Guanajuato	Guanajuato	21 1	6,757	2.060	18.1	64.6	8	1888–1889, 1895–1899, 1902.	BOM 1889, 1895–1899, 1902; CRM I, p. 20, II, p. 15.
Guaymas	Sonora	27 56			23.9	75.0	1	1902	BOM 1902.
Gutierrez Zamora	Vera Cruz	20 24*			23.2	73.8	3		CRM II, p. 135.
Huatusco	do	19 9	4,408	1,344	17.7	63.9	5		CRM II, p. 134.
Huayacocotla	do	20 38*			12.0	53.6	4		Do.
Huejutla	Hidalgo	21 9	1,246	380	22.7	72.9	2		Hann.
Ilamatlan	Vera Cruz				17.8	64.0	6		CRM II, p. 134.
Ixhuacan	do	19 21*			13.3	55.9	5		Do.
Ixhuatlan	do	20 41	1,004	306	23.4	74.1	6		CRM II, p. 135.
Ixtacomitan	Chiapas	17 10*	689	210	24.4	76.0	1	1884	MZ 1895, p. 387.
Jalacingo	Vera Cruz	19 49			13.9	57.0	4		CRM II, p. 134.
Jalapa	do	19 32	4,756	1,450	17.7	63.9	13	1895–1907	MS.
Jaltipan	do	17 58	436	123	26.5	79.7	5		CRM II, p. 136.
Jicaltepec	do	20 10	341	104	22.3	72.1	2		CRM II, p. 135.
Juchique	do	19 50*			21.1	70.0	5		Do.
Lagos	Jalisco	21 21	6,277	1,912	18.2	64.8	2	1879, 1896	Reyes, 1880. CRM II, p. 15.
Leon	Guanajuato	21 7	5,901	1,799	18.7	65.7	25	1878–1902	Bol. Obs. Met., Leon 1897; MZ 1897, p. 232; BOM 1897–1902; MWR 1897–1902.
Lerdo, Ciudad	Durango	25 33*	3,725	1,135	23.1	73.6	1	1902	BOM 1902.
Linares	Nuevo Leon	24 42 24 57*	1,190	363	22.4	72.3	5¼	1896–1901	BOM 1902, p. 22.
Magdalena	Vera Cruz	18 46*	5,087	1,551	18.4	65.1	5		CRM II, p. 134.
Do	Sonora	30 38	4,946	1,508	21.7	71.0	2	1896, 1897	Romero, p. 39. MWR 1897.
Maltrata	Vera Cruz	18 48*	5,255	1,602	17.0	62.6	6		CRM II, p. 134.
Martinez de la Torre	do	20 4	495	151	23.7	74.7	6		CRM II, p. 135.
Matamoros	Tamaulipas	25 53	49	15	23.2	73.8	9		Hann.
Mazatlan	Sinaloa	23 11	25	7.5	24.9	76.8	23	1880–1902	BOM 1901, 1902, and MS.
Mecayapan	Vera Cruz	18 13	1,115	340	22.9	73.2	5		CRM II, p. 135.
Medellin	do	19 3*	171	52	22.0	71.6	6		Do.
Merida	Yucatan	20 55	49	15	25.8	78.4	7	1895–1898, 1900–1902.	CRM I, p. 21; II, p. 15; MWR, 1897; BOM, 1898, 1900–1902.
Mexico City	Distrito Federal	19 26	7,469	2,277	15.5	60.0	26	1877–1902	MZ, 1897, p. 66; BOM, 1896–1902.
Minatitlan	Vera Cruz	17 59	213	65	24.1	75.4	4		CRM II, p. 135.
Mirador	do	19 15	3,293	1,004†	20.1	68.2	16	1854–1870	Schott; Sartorius, Bol. Soc. Geog. Estad. Rep. Mex. (2) I, p. 367–9 (1869).
Misantla	do	19 56	1,345	410	22.8	78.0	3		CRM II, p. 135.
Monterey	Nuevo Leon	25 40	1,624	495	21.5	70.7	10 3	1898, 1899, 1902.	Hann. BOM, 1898, 1899, 1902.
Morelia	Michoacan	19 42	6,399	1,951	16.8	62.2	9	1894–1902	BOM, 1895–1902; CRM I, p. 20; II, p. 14; MWR 1896–1902.
Naolinco	Vera Cruz	19 40*			16.0	60.8	5		CRM II, p. 134.
Naranjal	do	18 49*	2,558	780	21.3	70.3	5		CRM II, p. 135.
Nautla	do	20 13	10	3	23.1	73.6	2		Do.
Nogales	Sonora	31 20	3,857	1,176	17.2	63.0	1	1901–1902	BOM, 1901, 1902.
Oaxaca	Oaxaca	17 4	5,119	1,561	20.3	68.5	21	1879, 1883–1898, 1900–1905.	Reyes, 1880; MZ, 1896, p. 266; 1897, p. 385; 1905, p. 477; 1906, p. 467; BOM, 1895–1902 and ms.; CRM I, p. 20; II, p. 14.
Orizaba	Vera Cruz	18 51	4,215	1,285	18.2	64.8	6		CRM II, p. 134.
Otatitlan	do	18 11*	151	46	25.1	77.2	3		CRM II, p. 136.
Ozuluama	do	21 40	751	229	23.8	74.8	7		CRM II, p. 135.
Pabellon	Aguascalientes	22 4	6,311	1,924	18.1	64.6	12	1878–1889	BOM, 1888, p. 33; 1889, p. 370, 439.
Pachuca	Hidalgo	20 7	7,954	2,425	14.6	58.3	8	1894–1900, 1902	BOM, 1895–1900, 1902; CRM I, p. 20; II, p. 14.
Panuco	Vera Cruz	22 3*	66	20	22.9	73.2	6		CRM II, p. 135.
Papantla	do	20 27	977	298	22.7	72.9	5		Do.
Parras	Coahuila	25 28	5,033	1,534	23.1	78.6	23 mos.	1897–1898 1899	MWR, 1897, 1898. Mex. Intern. R. R. Co., 1900, timetable.
Paso de Ovejas	Vera Cruz	19 17*	423	129	25.4	77.7	2		CRM II, p. 136.
Patzcuaro	Michoacan	19 31	7,013	2,138	16.1	61.0	1	1879	Reyes, 1880.
Perla, La	Vera Cruz	18 57*			17.0	62.6	6		CRM II, p. 134.
Perote	do	19 34	8,085	2,465	10.5	50.9	6		Do.
Playa Vicente	do	17 50	312	95	24.1	75.4	4		CRM II, p. 135.
Porfirio Diaz, Ciudad	Coahuila	28 42*	722	220	21.3	70.3	7	1897–1903	MWR, 1897–1903.
Puebla	Puebla	19 2	7,118	2,170	15.9	60.6	25	1878–1902	Urrutia, Actas, etc., primer Congreso Meteor. de 1900, p. 165; BOM, 1900–1902.
Pueblo Viejo	Vera Cruz	22 12*			23.6	74.5	7		CRM II, p. 135.
Queretaro	Queretaro	20 36	6,068	1,850	18.1	64.6	8	1894–1900, 1902	BOM, 1895–1900, 1902; CRM I, p. 21; II, p. 14.

TABLE 1.—*Mean annual temperatures in Mexico*—Continued.

Locality.	State.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
			Feet.	Meters.	°C.	°F.	Years.	Date.	
Real del Monte	Hidalgo	° ′ 20 8	9,092	2,772	12.3	54.1	8	1889, 1894, 1896–1900, 1902.	BOM 1889, p. 369; 1895–1900, 1902; CRM II, p. 14.
Salina Cruz	Oaxaca	16 10	7	2	28.8	83.8	11 mos.	1902	BOM, 1902.
Saltillo	Coahuila	25 26*	5,379	1,640	17.6	63.7	10	1888, 1889, 1894–1900, 1902.	BOM, 1889, p. 370, 439; 1895–1900, 1902; CRM I, p. 21; II, p. 15.
Do	do				17.1	62.8	10		Hann.
San Andres Tuxtla	Vera Cruz	18 27	1,184	361	24.0	75.2	6		CRM II, p. 135.
San Cristobal Llave	do	18 43*‡			25.1	77.2	3		CRM II, p. 136.
San Juan Bautista	Tabasco	17 54	33	10	26.6	79.9	1	1892–1893	MZ, 1896, p. 478.
San Juan del Rio	Queretaro	20 22§	6,481	1,976	18.3	65.0	1	1879	Reyes, 1880.
San Juan Evangelista	Vera Cruz	17 53	289	88	23.5	74.3	5		CRM II, p. 135.
San Luis Potosi	San Luis Potosi	22 9	6,201	1,890	17.6	63.7	19	1879–1889, 1892, 1894–1897, 1899, 1900, 1902.	BOM, 1888, 1889, 1895–1897, 1899, 1900, 1902; MZ, 1894, p. 72; CRM I, p. 21; II, p. 15.
Santiago Huatusco	Vera Cruz				25.6	78.1	2		CRM II, p. 136.
Santiago Tuxtla	do	18 28*	935	285	23.8	74.8	5		CRM II, p. 135.
Santo Domingo	do	20 18*			18.7	65.7	5		CRM II, p. 134.
Silao	Guanajuato	20 56	6,061	1,848	19.4	67.0	4	1894, 1896, 1897, 1899.	BOM, 1896, 1897, 1899; CRM II, p. 15.
Soledad	Vera Cruz	19 4*	305	93	25.8	78.4	4		CRM II, p. 136.
Tacubaya	Distrito Federal	19 24	7,529	2,323	15.5	60.0	9		Romero, p. 38.
Tamiahua	Vera Cruz	21 16	0	0	24.2	75.6	3		CRM II, p. 135.
Tampico	Tamaulipas	22 16	0	0	24.0	76.0	4		Hann; BOM 1901, 1902.
Tantima	Vera Cruz	21 20	925	282	23.4	74.2	7		CRM II, p. 135.
Tantoyuca	do	21 21			23.0	73.4	6		Do
Tapachula	Chiapas	14 54*	590	180	28.8	83.8	2	1884–1885	Mattern, Mem. Soc. Cien. Antonio Alzate, I, p. 550–552, 1887.
Tehuipango	Vera Cruz	18 31	7,813	2,382	14.3	57.7	5		CRM II, p. 134.
Tempoal	do	21 28*			23.5	74.3	6		CRM II, p. 135.
Teocelo	do	19 28*	3,995	1,218	19.6	67.3	5		CRM II, p. 134.
Tepezintla	do	21 8*			22.9	73.2	5		CRM II, p. 135.
Tequila	do	18 44*	5,389	1,643	14.9	58.8	6		CRM II, p. 134.
Teziutlan	Puebla	19 49	6,501	1,982	15.6	60.1	1	1879	Reyes 1880.
Tihuatlan	Vera Cruz	20 43	729	222	24.4	76.0	5		CRM II, p. 135.
Tlacolulan	do	19 39*	5,448	1,661	14.8	58.6	3		CRM II, p. 134.
Tlacotalpan	do	18 37*	10	3	25.1	77.2	5		CRM II, p. 136.
Tlalixcoyan	do	18 48	275	84	24.7	75.5	5		Do
Toluca	Mexico	19 17	8,610	2,625	13.7	56.7	9	1894–1902	BOM, 1895, 1897, 1898, 1900–1902; CRM I, p. 21; II, p. 14; Bol. Red Meteor. Estado Mex., 1899, p. 132.
Topolobampo	Sinaloa	25 35*			23.9	75.0	35 mos.	1897, 1899–1901.	MWR. 1897, 1899–1901.
Tuxpan	Vera Cruz	20 59	0	0	24.8	76.6	6		CRM II, p. 136.
Tuxtla Gutierrez	Chiapas	16 32	1,738	530	24.6	76.3	3	1898–1900	BOM, 1898–1900.
Vera Cruz	Vera Cruz	19 12	49	15	25.0	77.0	22	1791–1803, 1847–1859, 1891–1894, 1896, 1902	Schott; BOM, 1902 and ms.
Veta Grande	Zacatecas	22 50	8,030	2,448	14.1	57.4	2	1839–1840	Schott.
Vigas, Las	Vera Cruz	19 38*	7,943	2,421	11.1	52.0	6		CRM II, p. 134.
Yecuatla	do	19 52*			21.4	70.5	5		CRM II, p. 135.
Zacatecas	Zacatecas	22 46	8,013	2,443	14.3	57.7	24	1878–1900, 1902.	BOM, 1888, 1889, 1895–1900, 1902 and ms.; CRM I, p. 20; II, p. 15.
Zapotlan	Jalisco	19 36	5,122	1,562	19.8	67.6	6	1894, 1896, 1899–1902	BOM, 1895, 1899–1902; CRM II, p. 14.
Zentla	Vera Cruz	19 7*			21.0	69.8	7		CRM II, p. 134.
Zongolica	do	18 40	4,107	1,252	18.6	65.5	5		Do

† This is the revised altitude given by Barcena (Anales Minist. Fomento, VII, p. 280, 1882); the earlier figures were 1095 meters (cf. Hann). ‡ None of the maps of Mexico show a S. Cristobal in the Canton of Vera Cruz, as CRM II, p. 136, locates it, but in the Canton of Cosamaloapan. § Romero's (p. 38) latitude of 19° 49′ for San Juan del Rio is not supported by the maps.

288, 1903, and Sr. J. Ramirez's "La Vegetación de México" in Anales del Ministerio de Fomento Rep. Mex. XI, pp. 227 et seq., 1898, of importance.

The sources from which the data have been gathered are frequently indicated in the accompanying tables by abbreviations whose significance is as follows:

BOM. Boletin Mensuel, Observatorio Meteorológico-Magnetico Central de México. México, 1888, 1889, 1895–1902. (Data for 1897 are also reprinted in Anales del Ministerio de Fomento de la Republica Mexicana, Tomo XI, p. 467–489. Mexico, 1898.)

Challenger Repts. Scientific Results of the Voyage of H. M. S. *Challenger*. Report on Atmospheric Circulation by Alexander Buchan, in Physics and Chemistry, Vol. II, part 5, London, 1889.

CRM. El Clima de la República Mexicana por M. Moreno y Anda y Antonio Gomez. Mexico Oficina tip. de la Secretaría de Fomento. Año I for 1895, 1899; Año II for 1896. 1900.

Hann. Handbuch der Klimatologie von Dr. J. Hann. Zweite Ausgabe. Bd. II, p. 286. Stuttgart, 1897.

MWR. The MONTHLY WEATHER REVIEW, United States Department of Agriculture, Weather Bureau, Washington, D. C. Volumes for 1896–1906.

MZ. Meteorologische Zeitschrift. Wien u. Berlin.

Reyes, 1880, in Boletin, Sociedad de Geografia y Estadistica, Republica Mexicana, 3a Epoca, V, p. 160–181.

Romero. Geographical and Statistical Notes on Mexico. By Matias Romero. G. P. Putnam's Sons. New York and London. 1898.

Schott. Tables in Smithsonian Contributions to Knowledge No. 277. Washington, 1876.

Some manuscript records in the library of the United States Weather Bureau from the Observatorio Meteorológico-Magnetico Central de México are often quoted as "ms." in connection with BOM. For the privilege of examining these I am indebted to the officials of the Weather Bureau.

The data for Cuernavaca for 1907 and for Jalapa 1895–1907 are from manuscript records from the meteorological observatories at those places, which I owe to the kindness of Señor Don M. E. Pastrana, Director of the Central Observatory of Mexico.

Latitudes and altitudes are taken from the authorities quoted for the temperatures; the determinations of the Comision Geografico-Exploradora for the State of Vera Cruz, in Revista, Sociedad Cientifica 'Antonio Alzate' xxiii, p. 31–32, Mexico, 1905; Anuario del Observatorio Astronomico Nacional de Tacubaya por 1901, p. 270–327 (latitudes only); Doctor Sapper's papers on Central America in Petermann's Mittheilungen xliii (1897), 1 (1904) und Ergänzungbänder xxiv (1895) and xxvii (1899); Mr. Gannett's "List of Altitudes in Mexico and Central and South America," Monthly Bulletin, International Bureau of the American Republics for September, 1904, Washington; and

TABLE 2.—*Mean annual temperatures in Central America.*

Locality.	Department.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
			Feet.	Meters.	°C.	°F.	Years.	Date.	
British Honduras.		° ′							
Belize		17 30	0	0	26.1	74.0	18	1863, 1865–1869, 1878–1883, 1885–1887, 1894–1895, 1902, 1904.	Schott; Challenger Repts.; Bristowe and Wright, Handbook of Brit. Hond., 3d edit., Edinb. and London, 1890, p. 231; MZ., 1896, 1906.
Guatemala.									
Chiacam	Alta Vera Paz	15 33*	2,788	850	21.3	70.3	4	1892, 1897–1899	MZ, 1894, 1900; Observ. Meteor. Lab. Quim. Cent. Guat., 1899 (1900).
Chimax	do	15 32	4,284	1,306	18.7	65.7	14	1892–1905	MZ, 1907, pp. 230–231.
Guatemala City	Guatemala	14 38	4,887	1,490	18.3	65.0	45	1857–1899, 1901, 1902.	MZ, 1899, p. 570; Observ. Meteor. Lab. Quim. Centr. Guat., 1899 (1900), 1902 (1903).
Mercedes, Las	Quezaltenango	14 42*	3,280	1,000	22.7	72.9	3	1896–1898	MZ, 1897, 1899.
Puerto Barrios	Izabal	15 44*	7	2	26.8	80.3	1	1896	MZ, 1897.
Quezaltenango	Quezaltenango	14 57 / 14 50*	7,708	2,350	14.6	58.3	3	1895–1897	MZ, 1896, 1897, 1898.
Salama	Baja Vera Paz	15 8	3,018	920	23.1	73.6	1	1891–1892	MZ, 1893.
Setal	Alta Vera Paz	15 42	2,394	730	20.6	69.1	1	1892	MZ, 1894.
Villafranca	Zacapa		2,004	611	23.0	73.4	1	1899	Observ. Meteor. Lab. Quim. Cent. Guat. 1899 (1900).
Honduras.									
Tegucigalpa		14 12*	3,200	976	22.3	72.1			Internat. Bureau Amer. Repub., Handbook for Honduras, 1904, p. 13.
Salvador.									
Bahia (estero de Jiquillisco)	Usulutan	13 13*			27.5	81.2	1	1876	Anales Mus. Nac., I. No. 7, San Salvador, 1904.
Barra del Lempa	do	13 16			27.5	81.5	1	1876	Do.
Jacuaran, Costa de	La Union	13 10* / 13 28			27.4	81.3	1	1876	Do.
Playa del Encantado	do	13 28			27.4†	81.3	1	1876	Do.
Puerto Concordia	La Paz	13 19			27.5	81.5	1	1876	Do.
Puerto de Acajutla	Sonsonate	13 35	50	15	26.1	79.0	1	1876	Do.
Puerto de La Libertad	La Libertad	13 26			26.1	79.0	1	1876	Do.
San Salvador	San Salvador	13 42	2,099	640	23.1	73.6	14	1889–1902	MZ, 1905, p. 87.
Santa Tecla	La Libertad	13 40*	3,001	915	21.6	70.9	4	1884–1887	MZ, 1896, p. 197.
Union, La	La Union	13 19* / 13 28	33	10	28.9	84.0	1	1876	Anales Mus. Nac., San Salvador, I, No. 7, 1904.
Nicaragua.									
Bluefields	Zelaya	12 0*			26.9	80.4	3	1883–1886	Challenger Repts.
Deseado, Rio, 10 miles from Caribbean.	S. Juan del Norte	10 52*			25.3	77.6	1	1898	Rep. Nicar. Canal Comm., 1897–1899 (1899); MWR, 1899, p. 212.
Greytown	do	10 55*			26.2	79.2	3	1898–1900	Do., and Rep. U. S. Isthm. Canal Comm., 1899–1901 (1904), p. 343–4.
Lajas, Las	Rivas	11 28*			26.6	79.9	1	1898–99	Rep. Nicar. Can. Comm., p. 307 (1899).
Ochoa (on Rio S. Juan, 40 miles from Caribbean).	S. Juan del Norte	10 47*			24.9	76.9	3	1898–1900	(Same as for Greytown.)
Rivas	Rivas	11 26*	209	61	26.8	80.2	7	1880–1886	Challenger Repts.
Rosa de Jericho, Hacienda	Matagalpa		over 3,300	over 1,006	17.2	63.0	14 mos.	1893–94	Niederlein, State of Nicaragua, Philadelphia Commercial Museums, 1898, p. 16–17.
Sabalos, Camp (on Rio S. Juan, 26 miles from Lake Nicaragua).	Chontales	11 2*			25.1	77.2	2	1898, 1900	(Same as for Greytown.)
San Carlos, Fuerte	Chontales	11 8*			25.7	78.3	1	1898–99	(Same as for Deseado.)
San Juan del Sur	Rivas	11 15*			25.1	77.2	1	1890	Bureau Amer. Repub. Handbook for Nicar. (Bull. 51) p. 19.
San Ubaldo	Chontales	11 51*	100	30	27.9	82.3	1	1900	Rep. U. S. Isthm. Canal Comm., 1899–1901, p. 343–4 (1904).
Sapoa	Rivas	11 15*	110	33	26.6	79.9	1	1900	Do.
Tola gage station	do	11 25*			27.1	80.7	1	1900	Do.
Costa Rica.									
Aguacaliente	Cartago	9 50*	4,362	1,330	18.1	64.6	11 mos.	1889–90	Anales Inst. Fis. Geog. Nac. Costa Rica, II, p. 153–5. 1890.
Heredia	Heredia	10 0*			21.1	70.0	1	1868	Schott.
Puerto Limon	Limon	10 0*	10	3	25.4	77.7	1	1902	Bol. Inst. Fis. Geog. Costa Rica, II. 1902.
San Jose	S. Jose				21.7	71.1	11	1868–1879	Challenger Repts.
Do	do	9 56	3,834	1,169	19.7	67.5	12	1889–1900	Bol. Inst. Fis. Geog. Costa. Rica, I–III, 1901–1903; MWR, 1901; MZ, 1902, p. 273.
Turrialba	Cartago	9 55*	2,034	620	20.2	68.3	1	1894	Anales Inst. Fis. Geog. Nac. Costa Rica, VII, p. 65.
Zent	Limon		66	20	25.8	78.4	23 mos.	1902–3	Bol. Inst. Fis. Geog. Costa Rica, II, III, 1902–3.
Panama.									
Alhajuela (on upper Chagres River).			143	44	26.5	79.6	4.6	1900–1904	MWR, 1904, p. 267–72.
Boca, La (on Bay of Panama).					26.5	79.6	4.8	1899–1904	Do.
Colon (formerly Aspinwall)					26.2	79.1	5	1862–1868	Schott.
Do		9 22	164?	50?	26.4	79.5	8	1881–1888	MZ, 1895, p. 105–110.
Gamboa		9 10	102	31	25.8	78.4	6		Do.
Naos (island near Panama)		8 57	46	14	27.1	80.8	6½		Do.

† The original has 21.4, apparently an error.

the Tablas de Alturas por los Dres. Felix y Lenk in Anales del Ministerio de Fomento de la Republica Mexicana, Tomo XI, p. 363–456, Mexico, 1898, and in Boletin de la Sociedad de Geografia y Estadisticta de la Republica Mexicana for 1894, p. 207 et seq.

Where no determinations of latitude have been found in these authors, measurements of the approximate latitudes have been made from the maps of the Secretaria de Estado y del Despacho de Fomento (Comision Geografica de Guerra y Fomento. Carta de la Republica Mexicana, Escala 1:100 000) in many sheets,[2] the Carta General de la Republica Mexicana of Manuel Fernandez Leal, 1899; the maps of the Bureau of American Republics for Mexico (1900), Guatemala (1902), Nicaragua (1903), and Costa Rica (1903); those of the Century Atlas, New York, 1906; those accompanying Doctor Sapper's papers above quoted, and Rand, McNally & Co.'s maps for Mexico and Central America. All latitudes obtained in this way are marked with an asterisk (*).

A comparison of the preceding data shows that a given mean annual temperature reaches farther north and to a greater elevation on the Pacific than on the Atlantic slope of Mexico. Thus, the highest point on the Atlantic slope attained by the isotherm of 25° C. is Actopan, in Vera Cruz, 311 meters elevation, whence the isotherm descends to sea level south of Tuxpan, 20° 59′ N. On the Pacific side the same isotherm

[2] Many of these sheets have also furnished altitudes.

reaches 488 meters at Colima and, at no great elevation, to north of Culiacan (24° 48′ N.). The isotherm of 20° has its greatest elevations on the Atlantic side at Mirador, Vera Cruz, 1,000 meters, and at about 700 meters in Nuevo Leon, while on the Pacific side it reaches 1,560 meters at Oaxaca, and as much in Sonora. (Compare Magdalena.) Deprest portions of the central plateau have a higher mean annual temperature than less elevated points in nearly the same latitude on the Atlantic slope. (Compare Lerdo and Monterey.)

These remarks are suggested by the assertion by a recent zoological writer (Gadow, Proceedings Zoological Society of London, 1905, II, p. 196) of the existence of a much cooler climate on the Pacific side than on the Atlantic side of Mexico at almost the same elevation.

Records of mean monthly temperatures for a considerable number of other Mexican localities exist in literature (e. g. MWR 1896–1906; BOM 1888, 1889, 1895–1902, 1904; Anales, Ministerio de Fomento Repub. Mex. I, p. 649 et seq., IX, p. 329 et seq.; Barcena and Perez, Estudios de Meteorologia Comparada, Mexico, 1885, etc.), but these monthly records are not sufficiently numerous or continuous to permit of calculations of the mean annual temperatures of their respective stations.

A SMALL CLOUDBURST NEAR SHASTA, CALIFORNIA.

By R. H. McCANDLESS. Dated Calpella, Cal., February 10, 1908.

The article on "Cloudbursts," by Mr. Edward L. Wells, Section Director, Boise, Idaho, published in the Yearbook for 1906, suggests that the ruggedness of the country has to do with these special phenomena, which certainly are not tornadoes or waterspouts, properly so-called. In this connection I would state that during the winter of 1890 I lived in the town of Shasta, Cal., and put in much of the time prospecting in the vicinity. On one of these trips I came upon the opening of a steep and narrow, rocky ravine, down which had recently poured a tremendous flood of water. Ascending this ravine, I noticed that the leaves and bushes on its sides were covered with mud and grass roots, showing that the water must have had a depth of at least 30 feet as it came down the gulch.

At the upper end of the ravine, or gulch as it would be called by the local miners, and just below the crest of the ridge, I found a place approximately 50 feet square, where all the soil and loose stones were completely washed away, together with the bushes and one pine tree nearly two feet in diameter, just as would have been done by turning a huge stream of water upon it under heavy pressure. The pine had been carried some distance down the gulch.

Standing upon the spot and carefully regarding all the evidence in sight, I could form no other conclusion but that here, within the past few days, had fallen a veritable river from the clouds, leaving nothing where it fell except the hard bed rock.

I saw many similar denuded spots in the vicinity, but none of so recent a date as to leave any positive evidence of the manner of denudation.

All of these denuded spots occurred within two miles of the town of Shasta and on the eastern side of the low range of hills surrounding it on the west, northwest, and southwest.

LOCAL CHANGES OF CLIMATE.

By W. C. DEVEREAUX, Local Forecaster. Dated Milwaukee, Wis., February 12, 1908.

I was much interested in the short editorial on "Changes in climate" which appeared in the Wisconsin Agriculturist, of January 30, 1908. As this is a most interesting subject I have carefully examined the records of this office with a view of discovering what changes, if any, have occurred in the climate of Wisconsin, and especially in this part of the State.

The statement is frequently made that the winters in this vicinity are gradually becoming milder and that the snowfall is decreasing. Just about a year ago the temperature fell to 50° below zero at two places in the northern part of the State, and this low reading has not been surpast by any known record in Wisconsin. On the 28th of the following April there was a heavy snowfall over the northern part of the State, while at Milwaukee on January 28 of the present year, 16.0 inches of snow fell in twenty-four hours, which is the heaviest fall that has occurred since the records began in 1885; and the total fall for January, 1908, was 29.0 inches, which is the third largest fall on record for that month.

The precipitation record at Milwaukee for the past thirty-seven years shows that over 50 inches fell in 1876, while there were only 18 inches in 1901. This might lead one to hastily conclude that the rainfall is decreasing very rapidly, but there appears to be no great cause for alarm, for the precipitation since 1901 has varied only 1 per cent from the average for the thirty-seven years.

The temperature record since 1870 shows no appreciable change in the climate at this place, the mean temperature for 1907 being only 0.3° above the normal. The highest temperature at this station was 100° on July 16, 1887, and again on July 20, 1901, while the coldest days were January 9, 1875, with 25° below zero; January 5, 1884, with 24° below; February 9, 1899, with 22° below, and January 25, 1904, with 23° below. These extremes in temperature are well distributed thruout the period covered by the records.

In reference to the prevailing idea that the rainfall is increasing in the arid country, I have carefully examined the records of several hundred stations in the arid and semiarid regions along the eastern slope of the Rocky Mountains, and find that the precipitation for 1907 was not only decidedly less than the average for the four preceding years, but was about 10 per cent below the average for the last twenty or thirty years. From this it would hardly be safe to infer that the rainfall is decreasing in that region, neither is it correct to conclude that the rainfall is increasing after a few comparatively wet years.

As one of the newspapers in this city well said in a recent issue—

> The seasons are likely to succeed each other for a longer time in the future than any one alive is likely to survive. There will be seed time and harvest. There will be blustering Marches and showery Aprils, and balmy Junes, and torrid Julys and Augusts. There will be pleasant autumns and bleak Decembers, and there will be winter cold as well as summer heat—just as there was in the olden times * * *. In those olden times, as now, there were open winters now and then, and cool summers now and then. But they were exceptional. The general run of weather in this latitude can be depended upon * * *. The open winter of the present year has been open enough to let in plenty of cold wind from the north and northwest to insure the success of the ice crop.

The United States Weather Bureau is interested in making an authentic record of the climatic conditions of the country and in distinguishing between an apparent change in the climate and the variability of the weather. If an appreciable climatic change should be discovered, Prof. Willis L. Moore, Chief of the Weather Bureau, would be prompt in publishing the fact, but as he stated[1] before the Committee on Agriculture of the House of Representatives, at Washington, D. C.:

> It is my duty to publish the simple, ungarnished facts in regard to the climatic conditions of the United States. Our people want the truth so that they may not be misled either by those who honestly, but nevertheless ignorantly, claim that hot winds and droughts will never again come, or by those who, when periods of deficient rainfall occur, as they have in the past and as they certainly will in the future, preach discouragement and the abandoning of lands which, on the average of a long period of years, it would be profitable to cultivate.

[1] See Monthly Weather Review January, 1907, Vol. XXXV, p. 13.